done by Herbert and Irene Baker on pollination syndromes and flower constituents. To my mind the Bakers' work is a sterling example of the high quality science that the study of pollination biology is capable of generating. Not mentioning their work is a disservice and deprives potential students of pollination biology of a great resource. The following papers (and the references therein) by the Bakers' should help fill the void for those potential students, and the present and future owners of this book: Baker and Baker, 1973, 1975, 1977, 1978; Baker et al., 1978. Oh yes, and remember, one can find the last ten years of the Bakers' work in their local library.—*P. J. DeVries, Smithsonian Tropical Research Institute, Box 2032, Balboa, Panama.*

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Pheromone Biochemistry.—Glenn D. Prestwich and Gary J. Blomquist (eds.). 1987. Academic Press. 565 pp. Cloth, $85.00 U.S.

Pheromones are the chemical signals of the most elementary communication system. After the first identification of such a substance, namely bombykol (1959), earlier hopes for a highly specific pest control with attractant pheromones were nourished. In the meantime, with modern chemical methods available, hundreds of such substances became known, mostly as rather precise mixtures of related or analogous compounds. Unfortunately, pheromones turned out not to be a panacea against pests, but at least have become useful to predict the threat of pest outbreaks. Worldwide, research on pheromones has mainly been done by the pragmatic entomologists, who are rightly worried about protection of plant, animal, and man, and less so by people in the basic disciplines. Pheromones occur all over the animal kingdom, yet, except for the insects and vertebrates, rather few have been studied in detail.

What could "pheromone biochemistry" mean? We are, on the *sender side,* dealing with glandular systems which produce these "exocrines or ektohormones," as they were called earlier. Is there anything functionally specific to be expected from such a wide variety of barely analogous glands? The book overcomes this dilemma by only treating selected pheromone-producing systems in some insects and ticks, with emphasis on female Lepidoptera. Just here—and also in the bark beetles—the interesting question arises about the biochemical basis of the specificity of the pher-

omone odor cocktails of related and/or sympatric species. Several chapters of the book deal with the fascinating biosynthetic machinery which is responsible for this. The expected diversity of these processes finds its parallel in the fact that different endocrine systems control the pheromone glands: neurohormones in the Lepidoptera, juvenile hormone in the bark-beetles and ecdysteroids in the flies and ticks. On the *receiving side,* pheromone-specific biochemical function cannot only be expected in relation to the specificity of the receptor binding but also with other transducing steps. Here, the state of our insight is even less advanced than on the sender side.

The first part of the book is introduced by two elegant chapters on "Structure and Function" of insect pheromones (J. H. Tumlinson and P. E. A. Teal) and the "Biology and Ultrastructure" of the respective insect glands (J. E. Percy-Cunningham and J. A. MacDonald). These are useful overviews which set the stage. The following chapters on pheromone production and hormonal control are important progress reports. "Desaturation and Chain Shortening" occurs during the biosynthesis of Lepidoptera pheromones from longer fatty acids (L. B. Björstad, W. A. Wolf, and W. R. Roelofs). The "Enzymes" which serve this function are described by D. Morse and E. Meighen, and the respective "Endocrine Regulation" by A. K. Raina and J. J. Menn. "Biosynthesis of Pheromones and Endocrine Regulation" in the beetles and flies is treated by D. Vanderwel and A. C. Dehlschlager, and by D. J. Blomquist, J. W. Dillwith, and T. S. Adams, respectively. Then follows a report on "Alkaloid Derived Pheromones and Sexual Selection" in some male Lepidoptera, which do not rely on the normal metabolites for the production of their pheromones as do their females, but ingest these plant products for their own protection, as nuptial gifts, and eventually as precursors for the biosynthesis of their signals (T. Eisner and J. Meinwald). "Neuroendocrine Regulation" of the pheromone related behavior of ticks is adequately treated by D. E. Sonenshine. The final chapter of this first part of the book describes "Cantharidine Biosynthesis and Function in Meloid Beetles" (J. P. Mccormick and J. E. Carrel). This is a fascinating defensive substance, yet doubtful as a pheromone. This long, laboratory manual style chapter is not well placed here.

How could "biochemistry" of the pheromone receptor organs differ from such a function in other olfactory receptors? Obviously by their specificity but not by their elementary properties. No doubt, electrophysiological studies are an essential first step to understand the specificity on the level of the receptor cells and this was the reason why I started 35 years ago to study olfaction in the silkmoth. The final third of the book begins with a fine treatment of the "Functional Morphology" of those antennal insect sensilla which respond to pheromones (R. A. Steinbrecht). These are the structures and compartments where the transducing processes occur. The corresponding "Neurobiology of Pheromone Reception" by J. J. DeKramer and J. Hemberger presents not only the established electrophysiological facts but also discusses controversial points, most of which are only distantly related to biochemistry and not too well placed in this book. Two chapters deal with olfactory biochemistry. R. G. Vogt ("Molecular Basis of Pheromone Reception") describes in a lengthy chapter his and other peoples' efforts to understand transduction phenomena in the sensillum lymph space. Degrading enzymes have been known for many years and the existence of pheromone binding proteins (with uncertain function) is rather well established. When these chapters were written, receptor protein identification was not yet successful. Yet recently these proteins have been "visualized" by using radiolabelled photoaffinity analogs (R. G. Vogt, G. D. Prestwich and L. M. Riddiford.

1988. J. Biol. Chem. 263:3952–3959). This publication provides remedies for some of the uncertainties of another rather long, often programmatic and technical chapter by G. D. Prestwich ("Reception and Catabolism"). Hopefully, some of his other claims on transducing functions in a number of species will also be verified soon. The final chapter is a good, compact treatment of the "Molecular Mechanism of Vertebrate Olfaction" with no specific relation to pheromones (nobody ever found specific pheromone receptor cells in noses, in contrast to insects). Interestingly, this chapter is meant to be an "introduction" for the insect people, yet is wrongly placed in this book.

In my personal view, the most important future result of pheromone biochemistry will be the understanding of how, and under what evolutionary pressure, speciation took place. The "royal" question is a behavioral one: any mutation which changes the composition of the signal or its receptor risks a misunderstanding or even a total blockage of the communication. There are indications that we are beginning to understand the respective mechanism on the sender side, yet we are still far from this goal on the receiving side.

Since many biochemical functions in pheromone systems are still largely unknown, it must have been difficult for the editors to plan this book. The result is a not too satisfying compromise. The book contains good general chapters with little biochemistry, a series of interesting biosynthesis chapters (some too packed with methods), confusing or even premature olfactorial chemistry, and two chapters which do not relate to the theme. One also wonders, whether the editors wanted essay-style chapters, reviews or methodological introductions?

For the insider, most chapters will be useful, for they tell in what direction the field is moving. Newcomers and students might like the introductory and overview parts. Unfortunately, some of the chapters even lack a summarizing paragraph and everybody will miss a final author index, which would help to use this book as a reference source.—*Dietrich Schneider, Max-Planck-Institut für Verhaltensphysiologie, D-8131 Seewiesen, Fed. Rep. Germany.*

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Portraits of South Australian Geometrid Moths.—Noel McFarland. 1988. Published by the author. iv + 400 pp., over 1,400 figs. $80.00 soft cover (includes packing and postage). Copies may be obtained from the author: P.O. Box 1404, Sierra Vista, Arizona 85636.

The author has had a long time interest in rearing Lepidoptera, especially members of the Geometridae. This goes back to when he was a young boy living in southern California; he became adept not only at life history work but also became well acquainted with the local fauna. During 1965–1969 he lived in South Australia, and continued his rearings of geometrids. But he was almost completely unprepared for "the mind-boggling array of incredible forms" that he found there, both as larvae and adults. Further, the great majority of these geometrids had never been studied or documented. It was at this time that he learned the necessary photographic techniques to be used to document the rearings. And, as they say, the rest is history, as seen in this most impressive volume.